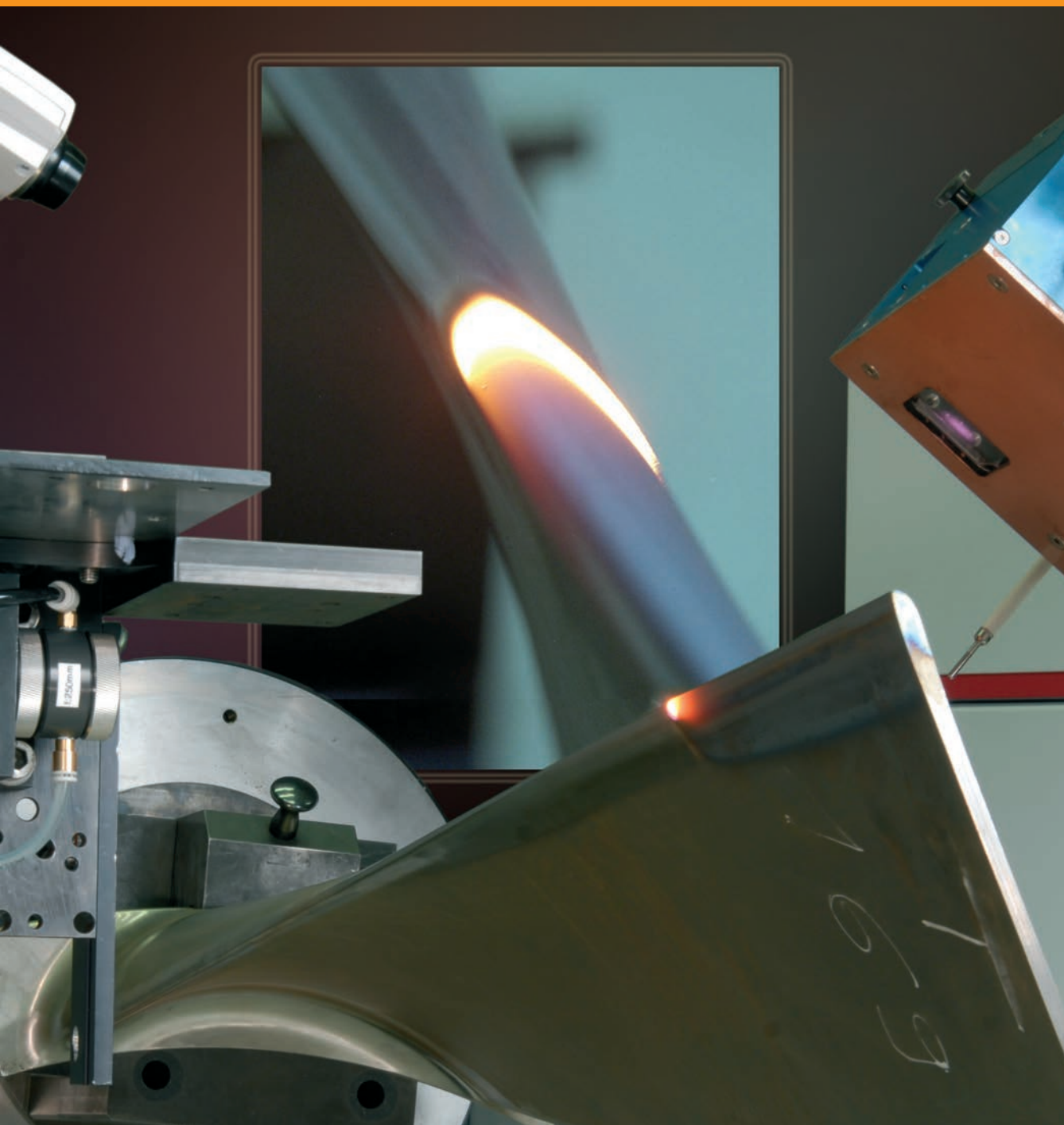
MODERN PRODUCTION TECHNOLOGIES
FROM THE FRAUNHOFER IWS

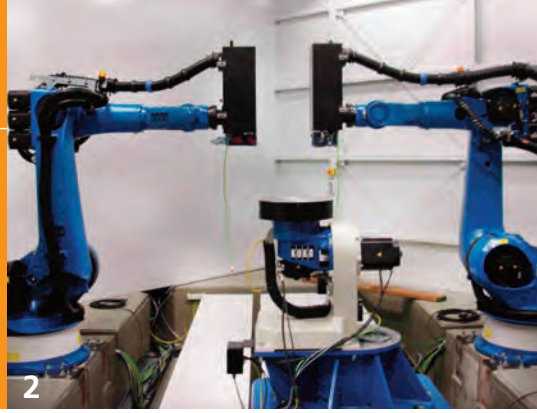


LASER - THE PERFECT TOOL FOR INCREASING THE SERVICE LIFE OF TURBINE BLADES

For more than a quarter of a century, the IWS has been working with laser assisted surface finishing processes to reduce the damage to turbines caused by condensed water droplets at low pressure. The water droplets destroy the leading edge of the turbine blades, which are designed for decades-long use. The result is considerable economic damage. With laser hardening with flexible beam shaping, scientists have found a solution for Martensitic hardened steel turbine blades which also deals with the constantly changing blade geometry. The result is a significantly increased wear resistance and, thanks to a hardness zone expansion, which will reduce stress, a significantly longer service life.

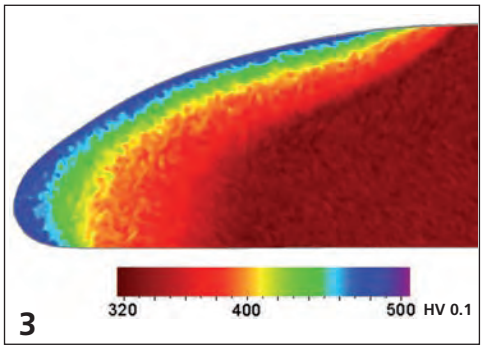
The question of how to increase the energy efficiency of steam turbines remains a topical issue for the IWS. The mechanical properties of Martensitic steels, however, are not sufficient to achieve the desired goal of free-standing, very long final stage blades with reduced gap loss without steam elements or the use of cover blades. Precipitation hardenable CR-NI steels were a suitable material for this purpose, however its use required the development of a new localized heat treatment technology for the leading edge.

0 Simultaneous, double sided laser solution heat treatment of a steam turbine blade's leading edge (collage)



"Hard surface - resistant core"

To solve this general problem, researchers of the Fraunhofer IWS have developed a new laser-assisted procedure for localized surface layer hardening. This process won them the 2006 Joseph-von-Fraunhofer Award. Through laser heat treatment of the surface layer with two semi-simultaneous working lasers and a subsequent hardening, they succeeded in producing a consistent wear and fatigue-resistant surface layer. The result is a hardness zone, geometrically optimally adapted to the localized wear and stress of turbine blades. A cavitation wear test shows that the damage to the turbines is reduced by two thirds. At the beginning of 2013, the Fraunhofer IWS installed a complex robotic system for the laser treatment of turbine blades at Siemens AG in Mühlheim/Ruhr thus handing this technology over to production.



After gathering conclusive data, around 34,000 laser hardened turbine blades are now stored or in use in more than 180 power plants worldwide (fig. 1). The so-equipped turbine rotors have a longer lifespan, and provide a higher electrical efficiency.

1 Turbine rotor on a low pressure level with laser hardened turbine blades.

2 Robot system for laser treatment of turbine blades at Siemens AG in Mühlheim/Ruhr

3 Color coded two-dimensional micro hardness distribution HV 0.1 of a laser hardened turbine blade